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Invasive Radiation Diagnostic Methods

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Abstract: This paper examines invasive radiation diagnostic methods. It is shown that angiography is one of the most modern radiological methods for assessing vascular patency, while coronary angiography evaluates the condition of the heart vessels. Radioisotope diagnostics, or scintigraphy, based on the use of radioactive isotopes to detect the absence or presence of various diseases.

Keywords: invasive, radiation method, diagnostics, angiography, coronary angiography , cardiac vessels, radioisotope, scintigraphy , lungs, angiopulmonography

November 8th is celebrated worldwide as World Radiology Day. This day celebrates radiological diagnostic methods used in medicine.

The X-ray method was the first to be discovered, back in the late 19th century. It was then that Wilhelm Conrad Röntgen noticed that when X-rays passed through a person's hand, an imprint of their bones remained on photographic film. This was the first way to determine the internal structure of the body without disturbing the integrity of tissue (incisions in the living or autopsies in the dead).

As a result, today there are two main types of X-ray examination methods: non-invasive and invasive, which involves the introduction of a radiocontrast agent into the body, which improves the quality of visualization of the organ or tissue of interest.

Invasive diagnostic methods differ from non-invasive ones in that before they are carried out, radiocontrast agents (most often barium or iodine) are introduced into the organ cavity or bloodstream .

The doctor then monitors the movement of this mixture in real time on a monitor. This is important when it's necessary to determine the dynamics of its movement and the shape of the organ it fills. Numerous examples can be cited in practical medicine.

X-ray of internal organs with contrast

Examination of the esophagus, stomach, and intestinal loops allows for the timely detection of peptic ulcers, neoplasms, foreign bodies, intestinal obstruction, etc.

By injecting contrast material through the cervix into the uterine cavity and then into the fallopian tubes, we can determine their patency. This method is extremely important when evaluating infertility.

Iodine contrast agents are used to examine bile ducts, as it's impossible to see movement through them in any other way. To determine the fistula's path, a radiocontrast agent is injected into it and its movement is also monitored.

This helps to avoid finding out the same thing during surgery, which is much more dangerous and traumatic for the patient.

It is known that fluoroscopy is more harmful to the patient than a single x-ray. The safe annual dose can sometimes be exceeded by as much as 100 times.

But, of course, it will not cause actual radiation sickness, but the illness that served as an indication for this study can lead to serious problems and sometimes even death.

Therefore, this examination method cannot be avoided.

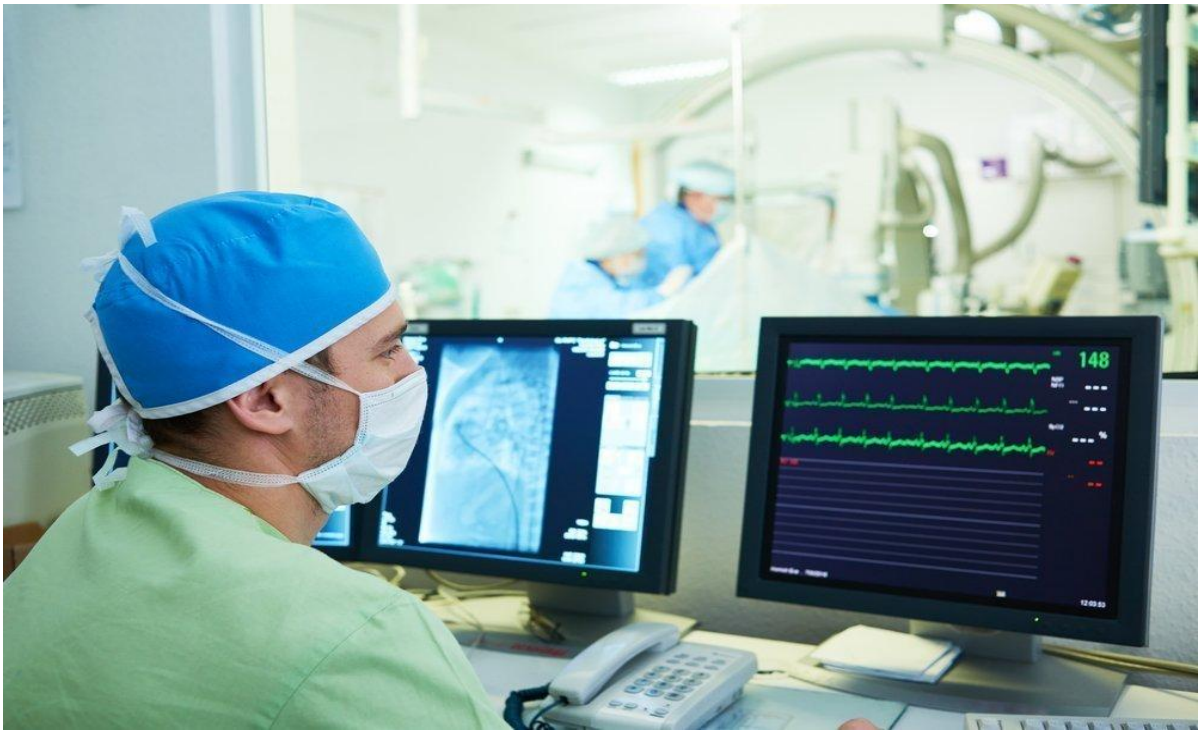


Fig. 1. The Angiography Process

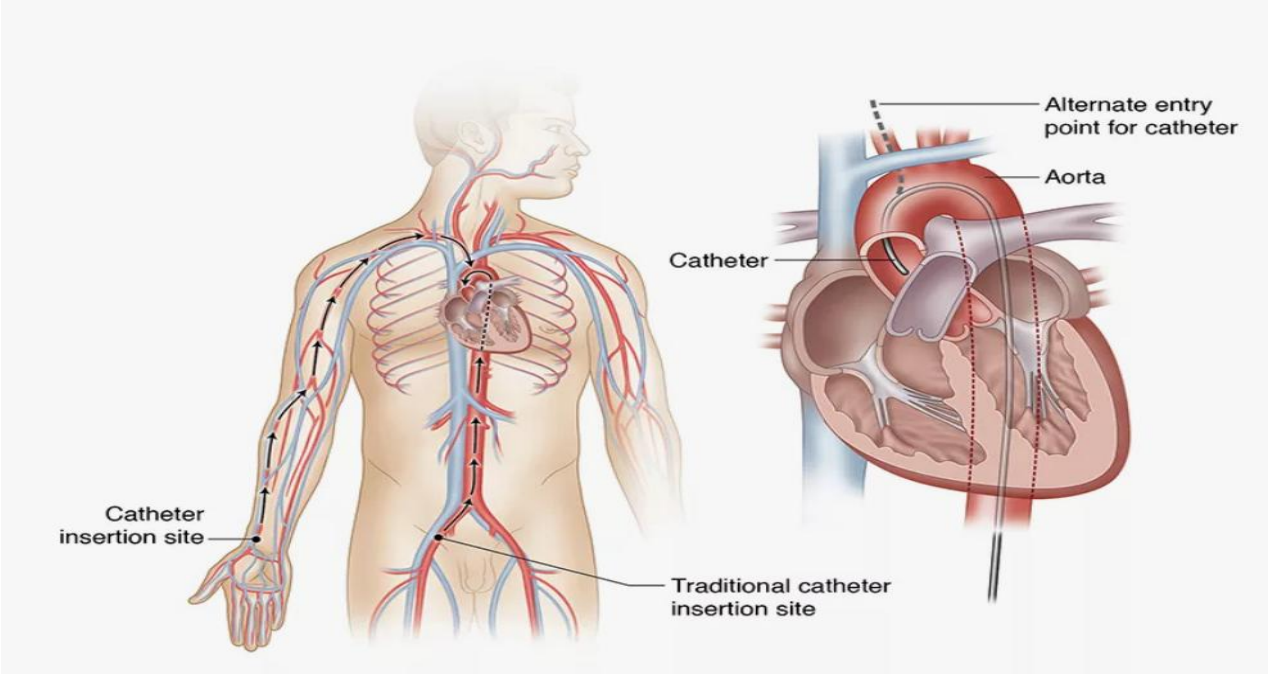
Angiography is one of the most modern radiological methods for assessing vascular patency. An iodinated contrast agent is injected through a puncture in the femoral or radial artery.

Pulmonary angiography (angiopulmonography) is an X-ray examination of the pulmonary arteries using a modern digital angiograph , allowing for visualization of all relevant structures in real time. Before the examination, a safe iodine-based radiocontrast agent is injected into the patient's bloodstream .

Angiography can be selective, which examines specific branches of the pulmonary artery, or general, which allows for the examination of all vessels in the pulmonary circulation. This procedure is prescribed by a physician and is performed by appointment.

This examination method is currently used in providing emergency care in life-threatening situations, as well as on a planned basis.

Coronary angiography is performed to assess the condition of the heart vessels. This is important in both acute myocardial infarction and long-standing coronary artery disease . This imaging method allows for precise localization of the lesion and decision-making on how to treat the patient.



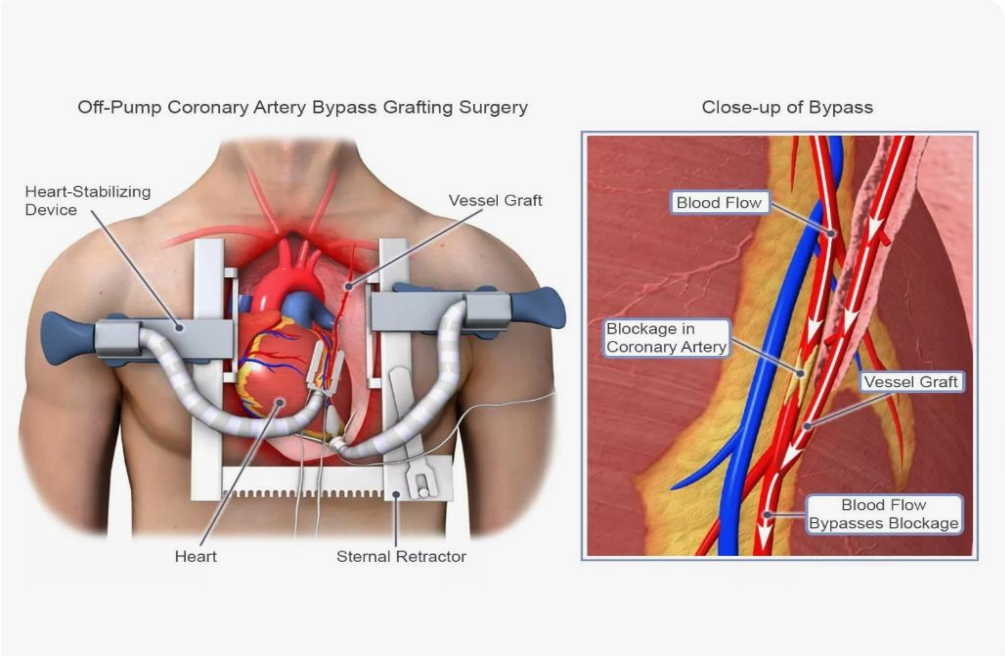


Fig. 2. The process of coronary angiography

Coronary angiography is a method of diagnosing heart vessels that is not performed as part of routine examinations. The equipment for this diagnostic method is far from cheap; only specialized cardiology centers have it, and not everyone is suitable for this type of diagnostic procedure. However, there are situations in which it is necessary.

The use of coronary angiography is justified in cases where there are obvious problems with the passage of blood through the coronary vessels, since the weakening of blood flow immediately affects the amount of oxygen supplied to the heart muscle (and not only), in which individual areas begin to die off (this is called ischemic heart disease).

As a reminder, the coronary vessels directly deliver oxygen-rich blood to the heart muscle. These vessels, also known as coronary arteries, are located on the surface of the heart.

- Angiopulmonography is performed if pulmonary embolism is suspected.

Fig. 3. The process of angiopulmonography

Angiography, an X-ray procedure used to accurately and thoroughly examine the lungs and their blood vessels, uses a special iodine-based contrast agent to improve visualization of the blood vessels.

Angiography can be performed using either conventional X-ray film or digital equipment that allows images to be saved on a computer.

The appointment of such a diagnostic procedure should be based on certain indications:

A lung tumor is suspected. For example, when an annual chest X-ray reveals a darkening of the lung, and the patient has specific health complaints (shortness of breath, weakness, etc.), an angiogram may be ordered to confirm the diagnosis.

There is a suspicion of intrapulmonary hemorrhage (it can occur due to trauma, improperly performed operations, etc.).

The patient presents with symptoms of pulmonary embolism. In this case, angiography is performed not only as a diagnostic procedure but also as a therapeutic procedure, during which heparin is injected into the pulmonary artery to promote clot dissolution.

- Examination of the vessels of the kidneys, liver, and brain allows us to identify the presence of structural anomalies, developmental defects, atherosclerosis, and thrombosis.

The radiation exposure during this examination is very high and sometimes amounts to 10-25 mSv .

However, angiography is never performed out of idle curiosity, as it requires compelling indications. Very often, the doctor's approach, determining the patient's fate, depends on the test results. In this case, the risk is entirely justified.

Radioisotope diagnostics or scintigraphy

This diagnostic method uses radioactive isotopes and compounds labeled with them to detect the presence or absence of various diseases. However, the pattern of this distribution varies between healthy organ tissue and diseased tissue, allowing the doctor to draw appropriate conclusions.

Most often, radioisotope diagnostics is used to detect diseases of the thyroid gland (if there is a suspicion of the presence of nodules or neoplasms), but it is also used to detect diseases of the lungs, liver, bones, brain, etc.

The radiation exposure associated with this diagnostic method is low, amounting to 0.2-0.4 mSv . Therefore, radioisotope diagnostics can be considered a relatively safe examination method.

Magnetic resonance imaging

Fig. 4. The MRI process

This type of examination at first glance resembles computed tomography, but in reality, the physical essence of the method is completely different. It is based on the excitation of atomic nuclei (most often hydrogen) by electromagnetic waves in a high-intensity constant magnetic field.

Thus, the doctor also evaluates a series of cross-sectional images of the area or organ of interest. However, the patient is not exposed to radiation, and from this perspective, magnetic resonance imaging (MRI) is completely safe. However, the presence of a pacemaker, metal structures (for example, in bones), and even a simple neck cross or gold dental crown can lead to problems.

Radiological imaging techniques are a true breakthrough in medicine. They allow us to detect diseases and make accurate diagnoses without violating the patient's integrity. They have saved billions of lives.

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